had a beautiful stand of *Prunus* — it must have been about 100 per cent.

MODERATOR CESARINI: Thank you, Mr. Bailey; that was a very good paper and I'm sure everyone is interested in ways to save money. Our next speaker is a personal friend of mine and one of the most progressive young men in our organization. I look up to him but I also feel sorry for him because he is filling in the position which was last held by our good friend, Mr. Martin Van Hof. I feel sorry for him because he has a lot of room to fill. At this point I introduce to you Mr. Larry Carville.

PROPAGATION OF SOFTWOOD CUTTINGS UNDER POLYETHYLENE TENTS

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Propagation by softwood cuttings under poly tents is not a new technique but it is a topic which merits periodic review by this Society. Over the years, as experimentation gives way to new methods, and as improvements are made to accepted techniques, we have a responsibility to the membership of our Society to spread the Gospel and share in the wealth of new knowledge.

The method currently being used by The Rhode Island Nurseries was developed and perfected by a valued friend of mine: my predecessor and the Dean of American Propagators, Mr. Martin Van Hof. Previous references to this subject can be found in papers by Mr. Roger Coggeshall in the 1953 edition of the Proceedings and by Mr. A. R. Buckley in the 1955 edition of the Proceedings. Mr. Van Hof began his experimentation with this method in the early 1950's and it has been perfected over the years. In my brief association with The Rhode Island Nurseries I have found this method to be extremely simple and at the same time highly successful.

Materials Propagated. Perhaps a logical approach to this subject would be first to tell you what material we are propagating under poly tents and then to briefly explain the mechanics of outdoor propagation under polyethylene tents. At the present time, we are successfully propagating *Cornus alba* 'Argenteo-marginata', *Deutzia gracilis, Euonymus* 'Sarcoxie', peegee hydrangea, *Kolkwitzia amabilis, Pachysandra terminalis* and several varieties of each of *Hibiscus syriacus, Hydrangea hortensis*, forsythia, ligustrum and weigelia. This list in no way limits the kind of material which may be rooted under poly tents but merely indicates what species we are sticking under poly.

Methods. Softwood cuttings are taken and prepared for sticking in the same manner as for mist propagation. We normally begin our poly tent propagation around July 15th, after we have completed all cuttings for the mist beds. All cuttings are taken early in the day and are treated with No. 3 Hormes powder prior to sticking.

The ground frames used in our operation are 32 feet long, 64 inches wide and have side boards which are 12 inches high. Frames are constructed on garden loam with a walkway of 24 inches between frames. The soil in the frame is tilled to a depth of 9 inches with a Howard Gem Rotavator, mixing in perlite at the rate of 24 cubic feet per frame during this initial operation. The rooting media is then raked smooth, tamped firmly and watered thoroughly. We are now ready to begin insertion of the cuttings.

Prepared cuttings are stuck with a dibble and are shaded and watered as the frame is filled. We find that placing a shade over the cuttings and placing wet burlap over the shade serves to maintain the cuttings in a turgid condition until the frame is covered with poly. It is of paramount importance to keep the cuttings as cool and moist as possible during this crucial period. A filled frame holds between 8,500 and 10,000 cuttings and with a crew of eight men, we are able to fill three frames every two days.

Covering the frame. When a frame is filled, the shades and burlap are removed. The cuttings are given a final heavy

Fig. 1. Frame filled with cuttings and ready for covering. Sideboards are 12 inches high. Center ridge, which will support the polyethylene, is a 1 x 2 nailed on 1 x 2 stakes.

Fig. 2. Frame is covered with 4 mil polyethylene, soil is tamped along the side-boards and metal "T" stakes are set in place preparatory to covering it with lath shade.

watering and preparations are made to cover the frame. One by two inch wooden vertical posts, 24 inches in length are driven into the soil to a depth of six inches down the middle of the frame from one end to the other. These posts will support the ridge board, a one-by-two inch strip which runs the entire length of the frame and which is nailed on top of the one-by-two inch posts. The distance from the top of the cuttings to the ridge is approximately 12 inches (Fig. 1). A trench four to five inches deep is now opened around the frame, approximately three inches from the bed boards and across the ends. This trench will secure the poly once it is stretched in place over the frame.

A roll of polyethylene, 4 mil in thickness and 10 feet wide is unrolled and cut to length. Using our eight man crew, the poly is pulled taut along the ridge, down over the side boards and is firmed in the trench. Soil is thrown into the trench and is tramped firmly. The poly over a completed frame should be tight, without sags and quite necessarily without tears. Any sags will have a tendency to collect rainwater and, if severe enough, could cause collapse of the frame.

At this point in the operation, shading becomes a critical factor since heat builds up very quickly in the closed frame. "T" irons 36 inches long are driven four feet apart in the walkways and across the ends of the frame to support the shades which are placed over the frame as quickly as possible. Initially we

use a shade which gives 75% shading, with 1½ inch laths spaced ½ inch apart. Our shades are seven feet long and four feet wide and nine shades are used to cover each frame. This allows for an overhang on each end of the frame to protect the cuttings from direct sunlight (Fig. 2) The entire operation from the time we begin placing the one-by-two inch posts until we have completed covering the frame with shades takes approximately 15 minutes but requires a great amount of teamwork. We have found, through the use of a recording thermometer, that the temperature within the frame prior to the period when shades are added has reached 120° F so that time is of the greatest essence in completing each step of the operation.

Opening the frame. The frames remain unattended during the rooting period but after about four to five weeks, one end of the poly may be pulled open to allow inspection of the rooting progress. Normally after five weeks, both poly ends are opened and the cuttings are allowed to harden off for two to three days. After three days, the poly is completely removed but the 75% shades are left in place. Hand watering is now required since the cuttings no longer have the benefit of a 100% humidity environment. By the early part of September, double shades (75% shade) are replaced by single shades which are six feet long, four feet wide and have 1½-inch laths spaced 1¼ inches apart. These shades are left in place over the cuttings until late September at which time all shades are removed. The one-by-two inch vertical posts and the one-by-two inch ridge board may also be removed at this time.

Overwintering. Cuttings require little care during late summer aside from an occasional thorough watering. As the rooted cuttings mature and harden off, and after several hard frosts, marsh hay is spread over the cuttings. This operation normally takes place in mid-December when the ground has begun to retain frost during the day. No additional winter protection is afforded the cuttings and they remain in place in the frames until spring. During early April, the marsh hay is removed and cuttings are pulled, trimmed and heeled into the frames preparatory to field planting. *Hydrangea macrophylla* varieties remain undisturbed in the frames until buds break, at which time they are planted in beds. *Pachysandra terminalis* is also planted in beds during early spring. As soon as ground in the nursery is workable in April, cuttings are pulled from the frames and hand planted in field rows, 31 inches between rows and three inch spacing between plants in the row. Plants remain in the field for one season and are dug, graded and stored during late November.

Advantages of poly tents. The advantages of softwood propagation under polyethylene tents are obvious at this point. Cost of production per cutting under poly is considerably less than under mist even though the poly is used for only one season. No elaborate structures such as mist-lines, time-clocks and sand-beds are required and we have a simple, easily constructed

dual purpose frame which requires little or no maintenance when constructed from redwood. One of the most outstanding features of this method is the lack of leaching of nutrients; such leaching may be one of the prime disadvantages of propagation under most mist systems.

Disadvantages of poly tents. I find one of the most frustrating drawbacks of propagation under poly tents is the fact that the cuttings cannot be readily observed. This may be merely a personal idiosyncrasy but I always prefer to have access to cuttings while they are in the rooting media. Closely allied to this first disadvantage is the fact that we have no convenient control of fungus infection which may develop during the rooting process. Since we have high humidity, no air circulation, and cuttings closely spaced in these frames, a fungus infection could cause a complete crop loss. We use no soil sterilants or fungicides on the soil prior to sticking cuttings and to date we have been fortunate. Another disadvantage is relative to weather conditions, since a prolonged period of cloudy, cool weather can delay rooting; in Newport, we often experience such prolonged periods of foggy, cool, weather during mid-August.

Summary. I would like to state, without reservation, that the advantages of propagation under poly tents more than outweigh the disadvantages. The cost of production per unit is substantially less than with most mist systems and no elaborate structures are required at any point during the operation. Presently, half of our entire softwood production is carried out under poly tents and we find this method completely satisfactory.

MODERATOR CESARINI: Thank you very much, Larry, for a very well presented paper. Sometimes I wonder what the nursery industry did before they invented polyethylene films. Our next speaker has been the propagator for the D. Hill Nursery Co. for over 4 years. At this point I introduce to you Mr. Peter Orum.

A PRACTICAL SYSTEM OF COLD-FRAME PROPAGATION

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Cold-frame propagation of ornamental woody plants has always been an accepted method. It has worked poorly and it has worked well, but seldom has it been very practical.

I once visited a large nursery in Germany. It was said to have several thousand glass-sashes in its propagation area. The amount of people needed to take care of this and carry sashes around ran almost into the hundreds.

Some years ago my close associate, John Wilde, and I started out with the goal of developing a practical system for